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Palmer

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[54] **SIGNALLING DEVICE**

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[58] **Field of Search** 181/113, 116, 117, 118, 181/142, 402; 367/144, 145, 146, 147, 131; 102/390, 392, 416

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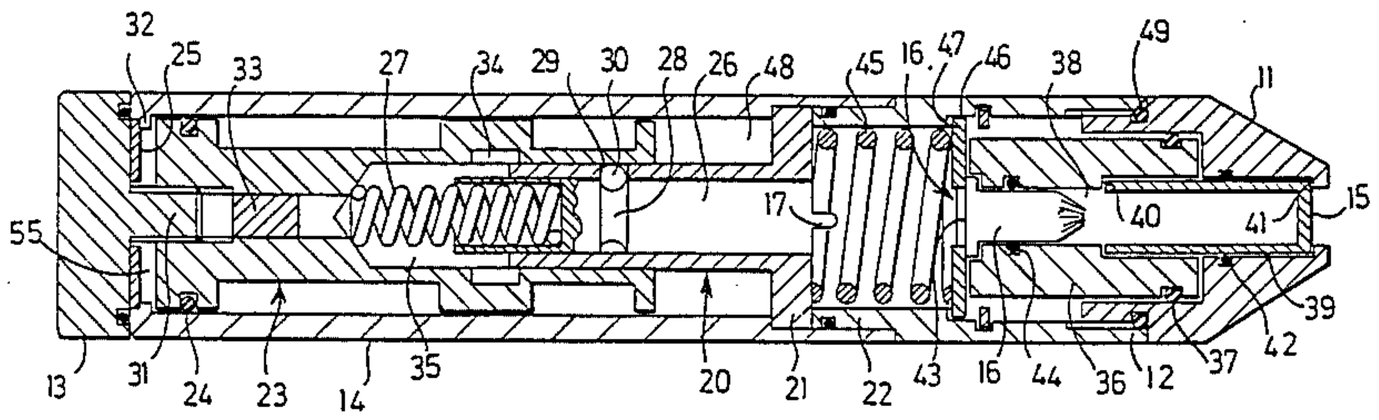
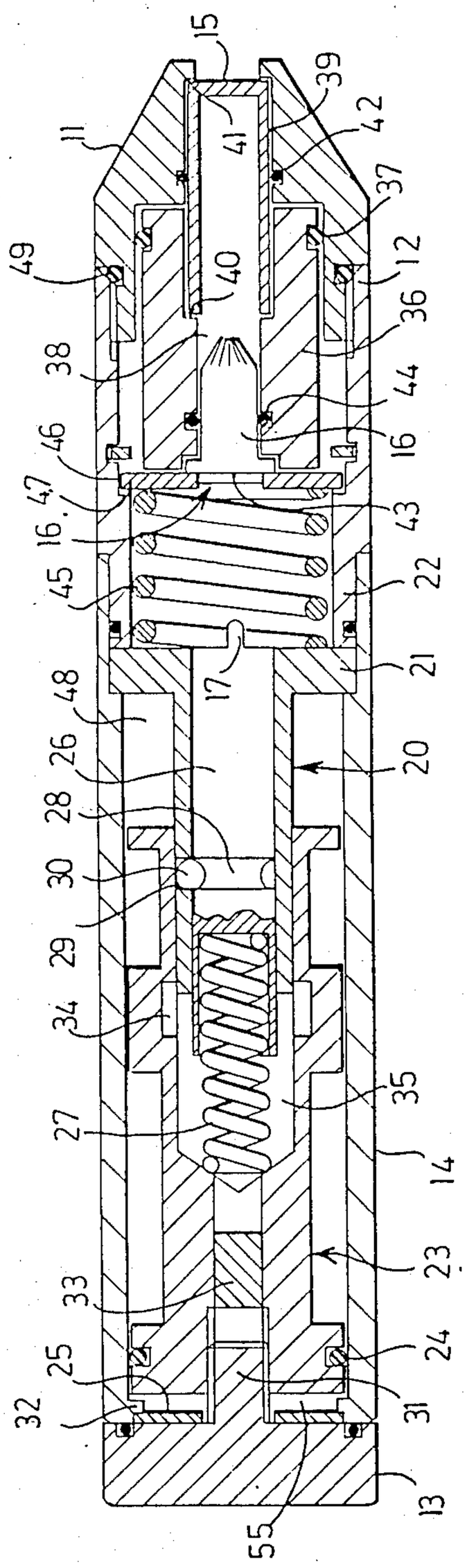
[57] **ABSTRACT**

A device for under-water signalling has a chamber (**38**) which is normally closed by a replaceable element (**39**). A cartridge (**16**) in the device can be fired to release gas into the chamber and rupture the element (**39**), thus causing a sound wave to travel through the water and releasing the contents of the chamber into the water. When an end cap (**13**) has been removed to prepare the device for use, water pressure can act on a piston (**23**) to cause firing of the cartridge.

8 Claims, 1 Drawing Figure

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SIGNALLING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to signalling and is primarily concerned with signalling between persons, at least one of whom is submerged in a body of water. One object of the invention is to provide a signalling device which is less elaborate than are known devices for underwater communication.

SUMMARY OF THE INVENTION

According to a first aspect of the invention, there is provided a signalling device comprising a hollow body within which there is a chamber, a closure element which normally closes the chamber off from a space outside the body, a source of gas adapted to charge the chamber with gas, whereby the pressure within the chamber can be increased to rupture the closure element, and triggering means for initiating release of gas from said source into the chamber, the closure element being adapted to be ruptured by a gas pressure within the chamber which the body can withstand without rupture.

If the outer face of the closure element is in contact with a body of water, rupture of the closure element by gas pressure within the chamber causes a sound wave to be transmitted through the water. Furthermore, rupturing of the closure element may release into the water from the chamber material which is adapted to provide a signal, for example a visual signal.

According to a second aspect of the invention, there is provided a method of signalling wherein a body of a signalling device is opened, an ambient pressure substantially above atmospheric pressure at sea level is exerted on an element within the body, said ambient pressure causes release of gas into a chamber in the body and the gas pressure within the chamber ruptures a closure element closing the chamber off from a space outside the body.

The body preferably includes first and second parts adapted to be released from each other and to be reassembled with each other by manipulation of the body parts and the closure element is preferably trapped between said parts. With this arrangement, the closure element can easily be replaced by a fresh closure element, during preparation of the device for reuse.

The source of gas is conveniently a cartridge comprising a combustible propellent and a percussion cap for igniting the propellent.

BRIEF DESCRIPTION OF THE DRAWING

An example of a signalling device embodying the first aspect of the invention and which can be used in a method according to the second aspect of the invention will now be described, with reference to the accompanying drawing, which shows a cross-section of the device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The device shown in the drawing comprises a body which includes a housing of generally cylindrical shape which is formed in four parts, namely a first end cap **11**, a shorter tubular part **12** on which the first end cap is fitted, a second end cap **13** and a longer tubular part **14**, on which the second end cap is fitted, the tubular parts **12** and **14** being connected to one another in coaxial

relation by a spigot and socket joint. The first end cap **11** defines an opening **15** to the interior of the body, is screwed into the housing part **12** and is sealed thereto by an O-ring seal **49**.

The joint between the housing parts **12** and **14** is provided for convenience in manufacture and assembly of the device only. These housing parts may be permanently secured together.

Within the shorter housing part **12**, there is disposed a source **16** of gas under pressure and within the longer housing part **14** there is disposed triggering means for initiating release of gas from the source. There is also disposed within the longer housing part a sleeve **20** having at one end a flange **21** which is a sliding fit within the housing part **14** and bears against an abutment constituted by a spigot **22** of the shorter tubular part **12** which extends into the longer tubular part **14**. This spigot is provided with an O-ring seal to prevent ingress of water at the joint between the housing parts **12** and **14**.

The sleeve **20** extends from the flange **21** in a direction away from the first end cap **11** into a driving element constituted by a hollow body **23**. This body is a sliding fit within the longer tubular part **14** of the housing and is adapted to act as a piston within the housing, being provided with an O-ring **24** which forms a sliding seal with the internal surface of the housing part **14**. There is also disposed within the housing part **14**, at a position adjacent to the second end cap **13**, a cover **25** which is fixed with respect to the housing, is formed with a central aperture and covers an annular surface of the body **23** which is presented towards the end cap **13**.

The end cap **13** is provided with an O-ring seal and is secured on the housing part **14** at the end thereof remote from the shorter housing part **12** to close the opening **55** defined by the housing part **14** and partly occupied by the cover **25**. When the end caps are both in position on the tubular parts of the housing and prior to use of the device, the housing is completely sealed against ingress of water. The components of the housing are conveniently formed of a plastics material which will not deteriorate when exposed to moisture.

Within the sleeve **20**, there is mounted a striker **26** which is massive relative to the body **23** and relative to the sleeve. The striker may be constructed of a solid piece of metal; whereas the sleeve **20** and body **23** are preferably formed of a plastics material. The striker is of generally cylindrical form and has at one end a nose **17**. In an end of the striker remote from the nose, there is provided a socket in which there is received an end portion of a resilient operating means in the form of a coiled compression spring **27**. An opposite end of the spring bears against a seal provided in the body **23**.

An annular groove **28** is formed in the circumferential surface of the striker **26** and, prior to use of the device, this groove is aligned with an aperture **29** in the sleeve **20**. In this aperture, there is disposed a retaining element in the form of a ball **30**. The ball is normally constrained by the internal surface of the body **23** to occupy a position in which it projects into the groove **28**. The ball **30** and sleeve **20** thus constitute holding means for holding the striker **26** releasably in a position in which the striker is spaced from the source of gas **16**.

The second end cap **13** is held in the position shown in the drawing by means of a screw-threaded spigot **31** on the end cap which extends into threaded engagement with the body **23**. The body **23** is thus retained in a

position adjacent to the end cap **13** with the cover **25** and a lip **32** on the housing part **14** being trapped between the body **23** and the end cap **13**. In the event of the device being dropped inadvertently, movement of the body **23** along the housing is prevented by the end cap **13** and movement of the sleeve **20** along the housing is prevented by the spigot **22** so that there is no risk of the striker **26** moving towards the source of gas **16**.

The body **23** can be freed for movement along the housing **10** by screwing the spigot **31** out of the body **23**. The device is thereby prepared for use. If the device is then thrown into water, it will sink and water will enter the housing through the aperture in the cover **25**. The ambient pressure will thus be exerted by the water on an end face of the body **23** and will tend to move that body along the housing towards the end cap **11**. Flow of water through the body **23** along a central passage defined thereby is prevented by a plug **33** formed of material which is impermeable to water and which is disposed in the passage of the body.

If the device, with the end cap **13** removed, is permitted to sink rapidly in water to a predetermined depth, for example **35** feet, the device is operated. The pressure exerted by the water on the body **23** moves the body towards the end cap **13** against the action of the spring **27** and compresses the spring between the body **23** and the striker **26**. In the radially inwardly facing surface of the hollow body **23**, there is formed an annular recess **34** which moves into alignment with the aperture **29** when the body approaches the flange **21**. The recess **34** is sufficiently large to permit the ball **30** to move out of the groove **28** in the striker when the ball is aligned with the recess **34**. The sides of the groove **28** are inclined to a longitudinal axis of the device to ensure that the ball **30** will be moved away from that axis by a camming action and into the recess **34**. In this way, the striker **26** is released for movement along the axis relative to the sleeve **20** and is propelled by the spring **27** towards the source of gas **16**.

A body of air which is trapped within the housing **10** constitutes a further operating means for exerting on the striker **26** a force which urges the striker towards the percussion cap **17**. This body of air is compressed by movement of the body **23** along the housing under the influence of externally applied pressure. The body of air occupies at least the space **35** between respective seats provided on the body **23** and on the striker **26** for engagement by the spring **27**.

In a case where the force exerted on the striker **26** at the moment when the striker is released for movement towards source of gas **16** is required to be determined by the spring **27**, communication is provided between the air space **35** and further air spaces around the periphery of the body **23**, between the striker and source of gas **16** and around the sleeve **20**. The total volume of these spaces is large, as compared with the reduction in the volume available to be occupied by the air contained in these spaces when the body **23** is moved along the housing sufficiently to release the striker. Accordingly, only a small increase in the pressure of air contained in these spaces occurs. Alternatively, the air which is trapped within the housing **10** and is compressed by movement of the body **23** along the housing may be required to exert a significant force on the striker **26** for urging that striker towards the source of gas. In this case, the further air spaces may be omitted, or the air space **35** may be sealed from these further air spaces. There may be provided between the external surface of the sleeve and the internal surface of the body **23** sufficient clearance to permit air to flow to the space **35** from the space **48** which lies outside the sleeve **20** and into which the body **23** moves when that body is moved along the housing. A sliding seal may be interposed between the body **23** and the housing part **14** adjacent to the air space **48**. In certain embodiments of the invention, the spring **27** may be omitted, air trapped in the air space **35** and in any communicating air space constituting the sole operating means for exerting force on the striker.

It will be noted that the device has no electrical circuit and therefore cannot be affected by extraneous electro-magnetic signals. The absence of a battery avoids one cause of unreliability in electrically operated signalling devices which are stored for a significant period.

The body of the device further includes a robust hollow cylinder **36** disposed partly within the end cap **11** and partly within the shorter housing part **12**. This cylinder is preferably formed of a metal which does not readily corrode, for example brass. An O-ring seal **37** is provided between the external surface of the cylinder **36** and the internal surface of the end cap **11**.

The cylinder **36** and the end cap **11** collectively define a cylindrical chamber **38** which normally contains air at atmospheric pressure and which is closed off from the space outside the device by a closure element **39**. The closure element is trapped between respective opposed shoulders **40** and **41** on the cylinder and on the end cap **11**. In the particular example illustrated, these shoulders are spaced a considerable distance apart and the closure element has the form of a tube with one closed end immediately adjacent to the opening **15** and one open end facing towards the source **16** of gas. The interface between the end cap **11** and the closure element **39** is sealed by an O-ring seal **42**.

The source of gas **16** is disposed in an end portion of the chamber **38** remote from the end cap **11** and is adapted to release gas into the chamber when struck by the nose **17** of the striker **26**. The source **16** may be in the form of a cartridge containing compressed gas. Alternatively, the source may be in the form of a cartridge containing a mixture or chemical compound which reacts to produce a gas. The preferred source of gas is a known blank cartridge having a percussion cap **43** and a charge of combustible propellent. The cartridge is fitted into an end portion of the cylinder **39** with a lip on a cap of the cartridge seating in an annular recess in an end face of the cylinder. An O-ring seal **44** is provided at the interface between the cartridge and the cylinder.

For maintaining the cartridge **16** firmly seated on the cylinder **39**, there is provided a resilient element **45** which acts, in effect, between the housing **10** and an annular plate **46** which overlaps the end face of the cartridge adjacent to the percussion cap **43**, the percussion cap being accessible to the nose **17** through a central opening defined by the plate **46**. The plate **46** is trapped between an end face of the cylinder **39** and a shoulder **47** on the shorter housing part **12**. In the particular example illustrated, the element **45** is a coiled compression spring seated on the plate **46** and on the flange **21**.

It will be seen that the spring **27** is not subjected to stress prior to use of the device. Thus, failure of any components of the device during storage is unlikely to lead to discharge of gas from the cartridge **16**. The device may be carried by a person under water without

the device being operated. That person can operate the device simply by removing the end cap **13**. alternatively, the device can be used by removing the end cap **13** and then lowering the device into a body of water. In either case, water enters the body of the device through the opening in the cover **25** and acts on the piston body **23** to compress the spring **27**. The device can be adapted to operate whenever the body **23** is subjected to any selected pressure which is significantly greater than atmospheric pressure at sea level.

When water at the predetermined pressure is admitted to the body, the striker **26** is projected towards the cartridge **16** so that the nose **17** strikes the percussion cap **43**. The propellent in the cartridge is ignited and reacts to release gas into the chamber **38** and to establish in that chamber a pressure such that the closure element **39** ruptures. This closure element is adapted to be ruptured by a pressure within the chamber **38** which is insufficient to rupture the body of the device. Rupture of the closure element **39** causes a sound wave to be transmitted through the water and also releases the contents of the chamber **38** into the water. A dye or other signalling medium may be provided in the chamber **38** so that this signalling medium will be released into the water when the closure element ruptures. The minimum pressure within the chamber **38** which ruptures the closure element **39** is considerably less than the minimum pressure in the chamber **38** which would permanently affect the housing **10** and other components. Accordingly, rupturing of the closure element **39** prevents other parts of the device being damaged by an increase in the pressure in the chamber **38**.

There is normally a small clearance between the plate **46** and the shoulder **47**. Movement of the plate towards the shoulder is opposed by the spring **45**. When combustion of the propellent in the cartridge **16** occurs, the recoil action of the cartridge is attenuated by movement of the plate **46** against the spring so that the shock transmitted to the housing **10** when the plate engages the shoulder **47** is less severe than would be the case if there were no clearance between the plate **46** and the shoulder **47**. We have found that the cartridge remains impermeable to water and remains sealed to the cylinder **39**, so that water is not permitted to enter parts of the device other than the chamber **38** when the closure element **39** is ruptured.

The device can be prepared for re-use by unscrewing the end cap **11** from the body part **12** and then withdrawing the cylinder **36** and the spent cartridge **16** from the body. The spent cartridge is removed from the cylinder and a fresh cartridge is inserted into the cylinder. The ruptured closure element is removed from the end cap **11** and a fresh closure element is inserted into the end cap. The cylinder **36** is then placed over the protruding part of the closure element and the assembly of end cap **11**, cylinder **36**, cartridge **16** and closure element **39** is applied to the remainder of the device, the end cap being screwed into the body part **12** until the O-ring **49** is compressed. During movement of the end cap into the body part, the spring **45** is compressed.

It will be seen that the device can be prepared for re-use by manipulation of the parts and tools are not required. The O-rings of the device are preferably coated with a silicone grease to facilitate assembly of the components. The triggering means is cocked by forcing the striker **26** along the sleeve **20** in a direction away from the body part **12** until the ball **30** can drop into the groove **29** in the striker. This frees the body **23** for movement under the action of the spring **27** to the position illustrated in the drawing.

The closure element **39** is preferably formed of a plastics material. A suitable closure element is formed of polyethylene and has a wall thickness, both peripheral wall and end wall, in the region of 1.5 mm. It will be noted that considerably less than one half the volume of the chamber **38** is occupied by the cartridge **16** and that the volume of the air space in the chamber is considerably greater than the volume of the cartridge.

It will also be noted that a part of the length of the closure element **39** lies within the cylinder **36** and a further, approximately equal part of that length lies in the end cap **11**. It will also be noted that the external periphery of the cylinder **36** engages only with the O-ring **37**.

Whilst the opening **15** is conveniently positioned at one end of the device, it may alternatively be positioned at a side of the device. In this case, the closure element would be a somewhat shorter tube than that illustrated or may be a disc.

The cover **25** is permanently secured on the body part **14** and has a central opening of fairly small diameter which restricts access to the body **23**, even when the end cap **13** has been removed. Thus, a user cannot insert a finger through the cover to exert force on the body **23**. Access through the opening **25** to the body **23** may be further obstructed, provided water can enter the device to act on the body **23**.

The invention disclosed herein has diverse forms, not limited to the subject matter of the following claims and means for carrying into effect the specific features disclosed in the foregoing description, in the following claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention.

What is claimed is:

1. A signalling device comprising:

a hollow body within which there is a chamber,

a closure element which normally closes the chamber off from space outside the hollow body,

a source of gas adapted to charge the chamber with gas, whereby the pressure within the chamber is increased to rupture the closure element, and

triggering means for initiating release of gas from said source into the chamber,

wherein the hollow body includes first and second parts provided with respective threads which are mutually engaged to hold the parts releasably together, said first and second body parts having respective annular shoulders facing in respective directions along the threads towards each other, both shoulders being engaged with the closure element to trap the closure element between the shoulders, said closure element being adapted to be ruptured by a gas pressure within the chamber which gas pressure the hollow body can withstand without rupture.

2. A device according to claim **1** wherein the triggering means is adapted to initiate release of gas into the chamber when the device is subjected to a predetermined ambient pressure.

3. A device according to claim **1** wherein the source of gas is a mixture or chemical compound which reacts to produce the gas.

4. A device according to claim **1** further comprising:

a sealing element mounted in the hollow body at a position between said annular shoulders and en-

gaged with the closure element to seal the closure element to one of said first and second parts against ingress of water.

5. A signalling device comprising:

a hollow body within which there is a chamber,

a closure element which normally closes the chamber off from space outside the body, a source of gas which is a cartridge including a propellent and a percussion cap means for igniting the propellent to charge the chamber with gas, whereby the pressure within the chamber is increased to rupture the closure element, and

triggering means for striking the percussion cap means to initiate the generation of gas from said propellent,

wherein the closure element is adapted to be ruptured by a gas pressure within the chamber which the hollow body can withstand without rupture.

6. A signalling device comprising:

a hollow body within which there is a chamber,

a closure element which normally closes the chamber off from space outside the hollow body,

a source of gas adapted to charge the chamber with gas, where the pressure within the chamber is increased to rupture the closure element, and

triggering means for initiating release of gas from said source into the chamber,

wherein the hollow body includes a housing part and a removable end cap fitted on the housing part, said housing part and said end cap having respective shoulders facing towards each other and both being engaged with the closure element, said closure element being trapped between said shoulders, and wherein the closure element is adapted to be ruptured by a gas pressure within the chamber which the body can withstand without rupture.

7. A device according to claim 6 further comprising:

a second removable end cap which closes an opening to the interior of the hollow body and which second removable end cap can be removed to admit ambient pressure to the interior of the hollow body.

8. A signalling device comprising:

a hollow body within which there is a chamber,

a closure element which normally closes the chamber off from space outside the hollow body,

a source of gas adapted to charge the chamber with gas, whereby the pressure within the chamber is increased to rupture the closure element, and

triggering means for initiating release of gas from said source into the chamber,

wherein the hollow body includes first and second separable body parts, said first body part being a cylinder and having means for guiding the second body part along an axis of the cylinder into and out of assembled relationship with said first body part and for releasably retaining the second body part in assembled relationship with the first body part, wherein the first and second body parts have respective shoulders facing towards each other, wherein the closure element is trapped between said shoulders, and wherein the closure element is adapted to be ruptured by a gas pressure within the chamber which gas pressure the hollow body can withstand without rupture.

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